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THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

GEORGE BENJAMIN FILLMORE—*a portrait* 136

GEORGE BENJAMIN FILLMORE—*a biography* 137

Editorial 138

A Difficult Pipe-Line River Crossing 139
By PHILIP R. HAMMOND

Island Creek's Mine No. 27 at Scarlet, West Virginia 144
By NICHOLAS T. CAMICIA

TCI's Dolomah Quarry Honored for Safety Achievements 148

Tales of a Gold Miner in Nicaragua 150
By C. CARLETON SEMPLE

Blasting Rock Tunnels Under a Pittsburgh Residential District 155
By E. DONALD PHINNEY

Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

A pipe-line river-crossing job recently completed successfully at Lake Butte des Morts, near Oshkosh, Wisconsin, by G. G. Griffis, Inc., required unusual skill in blasting with industrial explosives and a high degree of coordinated teamwork by the contractor's crews.

The project called for laying 5,820 ft. of 10-in. pipe in swampy shores on both sides of the lake, and in the bed of the lake. Ditches 6 ft. deep, totaling 2,100 ft. in length, were blasted in the swamps. In the lake bottom, a trench 6 ft. deep was blasted for a distance of 3,720 ft.

A description of the operating methods and the equipment used by the Griffis Company in Wisconsin is included in the article beginning on page 139.

**

Island Creek Coal Company, Huntington, West Virginia, has expanded its mining and plant facilities during recent years, to keep pace with the growing demand for high-quality coals. The latest development in this expansion program is Mine No. 27, located in a narrow valley surrounded by heavily wooded mountains, at Scarlet, Mingo County, West Virginia. Operations are carried on in the lower Thacker coal seam of the Kanawha series, varying in height from 40 to 65 in., free of partings.

The work cycle at this new, modern coal mine was adopted as standard practice by the operating department, after numerous time studies and analytical work had been completed by the company's industrial engineers. For further details, please turn to page 144.

**

Officials, employes, and guests of Tennessee Coal, Iron and Railroad Company met together at the company's quarry property in Bessemer, Alabama, August 2, 1950, to honor their Dolomah quarrymen for their record of no lost-time accidents in 285,223 man-hours of work in 1949, the best in the quarry group in the National Safety Competition. In recognition of their splendid accomplishment, they were awarded the Sentinels of Safety trophy and flag as a group, and each quarry employe received an individual Certificate of Achievement in Safety, signed by the Director of the U. S. Bureau of Mines. An account of the ceremony begins on page 148.

**

C. Carleton Semple, author of the article "Tales of a Gold Miner in Nicaragua," started out to write a serious account of how mining operations were carried on in that country during peacetime and wartime adversities. However, recollections of other events at other mines in other climes kept recurring. He decided to include anecdotes about people and incidents he met with in line of duty, remarking, "often they are more interesting and present problems less easy to solve than technical ones—at times more amusing or more annoying."

Part I in a series of articles may be found on page 150.

**

A high-speed traffic artery is under construction by the Pennsylvania Department of Highways, to relieve vehicular congestion in the Pittsburgh area. One important unit in this superhighway project is the driving of the twin-bore Squirrel Hill Tunnel. How the contractor, B. Perini & Sons, Inc., Associated, Framingham, Massachusetts, carried on rock-tunnel operations under a residential district is outlined in the article beginning on page 155.

EDITORIAL STAFF: Joseph J. Duffy, *Managing Editor*; Elizabeth M. Jones, *Assistant Editor*; Edward L. Cramer, *Art Editor*; Frank J. Cassin, *Production Manager*; Charles B. Rainwater, *Advertising Manager*; Theodore Mayer, *Director*; Montgomery B. Rose, *Associate Director*.

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GEORGE BENJAMIN FILLMORE

George Benjamin Fillmore

PRESIDENT

THE HUDSON COAL COMPANY

A Biography

GEORGE BENJAMIN FILLMORE, president of The Hudson Coal Company, Scranton, Pennsylvania, has been associated with the anthracite industry for thirty-eight years, and is the third generation of the Fillmore family to be identified with the industry. The story of his life reveals another example of the success that comes from early devotion to one field of activity and the continuous and energetic concentration of natural abilities in the chosen field.

Ben, as he is known to his friends and associates, was born in Taylor, Lackawanna County, Pennsylvania, the son of Harry Atherton and Emma (Sands) Fillmore. His father, who was active in the anthracite industry throughout his entire business life, was associated with the DL&W Coal Company (now the Glen Alden Coal Company) and the West End Coal Company, Shickshinny, Pennsylvania. At the time of his retirement, he was general manager for Dickson & Eddy's West End operations. Later, he wrote several articles about the anthracite industry for *The Saturday Evening Post*.

Ben Fillmore completed the prescribed courses in primary and high schools in Shickshinny, and at Wyoming Seminary, Kingston, Pennsylvania, after which he entered Lafayette College at Easton, from where he was graduated in 1912, with a degree in electrical engineering. While at college, he played on the football and baseball teams, and was elected president of his class.

Ben's first job was in the summer months for the DL&W Coal Company, handling supplies in the storehouse and machine shop. From 1910 through 1911, during vacations, he worked in the mines, breaker, and shops of the West End Coal Company. Following his graduation from college, he went to work for West End Coal Company as an assistant foreman and continued in that capacity until late in 1918. In January, 1919, he began his association with The Hudson Coal Company as a special engineer. A few months later, he was moved up to the job of chief inspector. Promotions followed through the positions of assistant general sales agent, general sales agent, vice president, and senior vice president. On January 1, 1950, he was elected president of the company.

In addition to his responsibilities as president and a director of The Hudson Coal Company, Mr. Fillmore is a director of The Anthracite Institute, a member of both the Anthracite Operators' Wage Agreement Committee and Anthracite Producers' Advisory Board; president of Township Realty Corporation; and a member and trustee of Green Ridge Presbyterian Church, Scranton, Pennsylvania. During World War II, he was a member of the Solid Fuel Committee, by appointment from U. S. Secretary of the Interior Harold L. Ickes.

George Benjamin Fillmore married Naomi Elizabeth Allen, October 2, 1913, in West Nanticoke, Pennsylvania. They have two sons, George Benjamin, Jr., of Syracuse, New York, and Robert Allen, of Drexel Hill, Pennsylvania; also, two grandchildren, George Benjamin, III, and Elizabeth Jane Fillmore, the son and daughter of Ben, Jr. The family home is at 1630 Wyoming Avenue in Scranton.

Ben Fillmore is a member of the Lafayette College chapter of Delta Kappa Epsilon fraternity. His club memberships include Scranton and Green Ridge in Scranton, Westmoreland in Wilkes-Barre, Sky Top at Sky Top, Maroon at Easton, and the Country Club of Scranton at Clarks Summit, all in Pennsylvania.

When opportunity permits, Ben finds relaxation in his principal hobbies—playing golf and at the bridge table with his family and friends.

The Steel Situation Summarized

AN EDITORIAL

A SUMMARY of the current situation in steel was given recently by Benjamin F. Fairless, president of United States Steel Corporation, in an address before the Philadelphia Chapter of the National Association of Purchasing Agents. The figures he cited are impressive. Since 1939, American steel production has been expanded by more than 47 million tons. This is a 90 per cent increase, six times as great as our population growth during that period. In 1943, American manufacturers produced more goods than in any other year before or since. Not even today is our nation's total industrial production as high as it was then. However, today the steel industry is pouring nearly 12 million more tons of ingots than it did then. Today, the steel industry in the United States is larger, by 14 million tons, than the combined production of all the other nations on earth.

"We are suddenly confronted by civilian demands," said Mr. Fairless, "that normally would have been spaced out over several years. At the same time we are facing a flood of defense and military orders that might never have been forthcoming at all under other, happier, circumstances. And just as all these demands have been compressed suddenly into one tremendous package, so the steel industry is now compressing into the space of a few months a construction program that normally would have been spread out over many years to come.

The Search for Ores

"Many years ago," continued Mr. Fairless, "long before there was any great public concern about it, the American steel industry began to worry about a possible shortage of iron ore. It was clear that the high-grade, open-pit ores of the famed Mesabi Range were running low and might not last much more than 20 years longer if they were not conserved. It was probable, of course, that the rich, hard-to-get metal in the underground mines would add enough to these resources to carry us well beyond the anticipated lifetime of most of the men who were then doing the worrying, but not beyond the expected needs of a nation that is only now in the first vigor of its youth.

"So the search for foreign ores began in earnest, and while the geologists of U. S. Steel were combing the globe for the strike they finally made at Cerro Bolivar in Venezuela, our competitors, with equal perseverance and courage, were finding other deposits in Canada, Labrador, Liberia, and South America.

"Hundreds of millions of tons of the world's richest ores were thus added to America's resources, but still the industry was not content because these sources might be cut off in time of war, and because the biggest iron treasure of them all lay right here at home—in the taconite deposits of our own Lake Superior region.

"Taconite is just about the hardest, toughest rock you ever saw. It is estimated that some 72 billion tons of it are in this country, and about one-third of that is iron. The trouble is that this iron is scattered through the rock in tiny particles and the problem has been to separate those articles of iron from the rock. . . . It is a problem upon which the laboratories of the entire industry have spent many, many years and many more millions of dollars; but today we think we've got it licked. We are building our plants now, and after that will come a host of great ore factories to separate and concentrate, agglomerate and nodulize this iron."

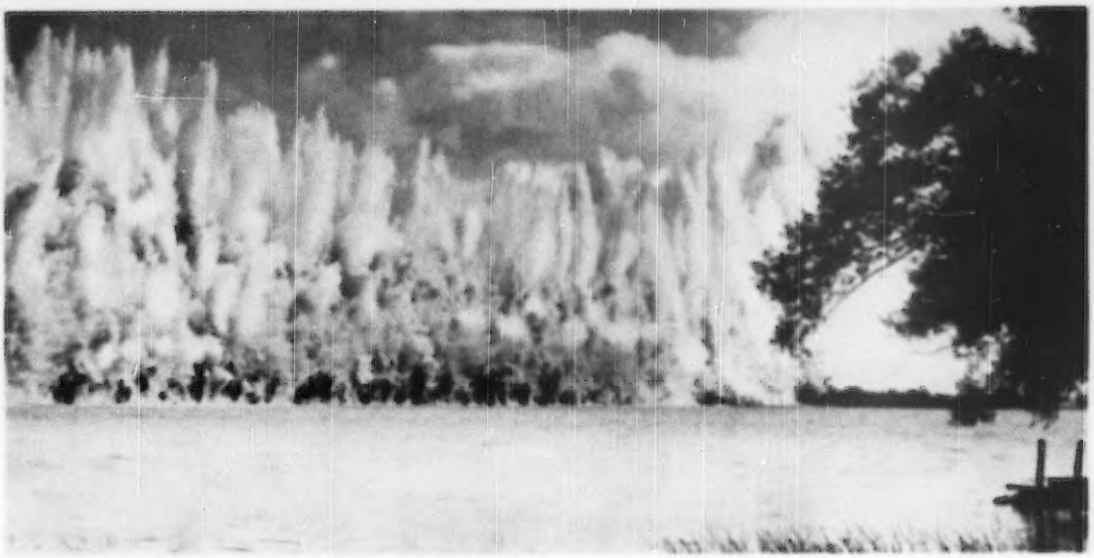
In conclusion, Mr. Fairless stated, "Whatever else the history of this great country of ours may hold, I think it must then be recorded that the American steel industry—in these years of patient exploration and research—has given the people of America all the iron they will need for a long, long time to come."

Keeping Pace with the Growth of Our Economy

Charles Sawyer, Secretary of Commerce, confirmed these facts in a recent news release. He quotes figures from the American Iron and Steel Institute to the effect that capacity will be increased by 9,400,000 net tons from July 1, 1950, to December 1, 1952.

"Even if the present goal is not exceeded, as it well may be, by the end of 1952 the steel-producing capacity of this country will have been increased by 16 million tons over the capacity in the year 1944, which was the peak capacity of the war years. The peak of military requirements and consumption during World War II was in 1943 when 53 million ingot tons of steel were required. By the end of 1952 our steel capacity will be more than double that figure.

"These figures indicate that the expanding steel capacity is keeping pace with the general growth of our economy. In the light of the excess of capacity over the peak military demand during World War II, it would appear that to a large extent the tremendous increase in steel capacity will thus be devoted to maintaining the growth of our economy, which is one of the fundamental bases of our strength."

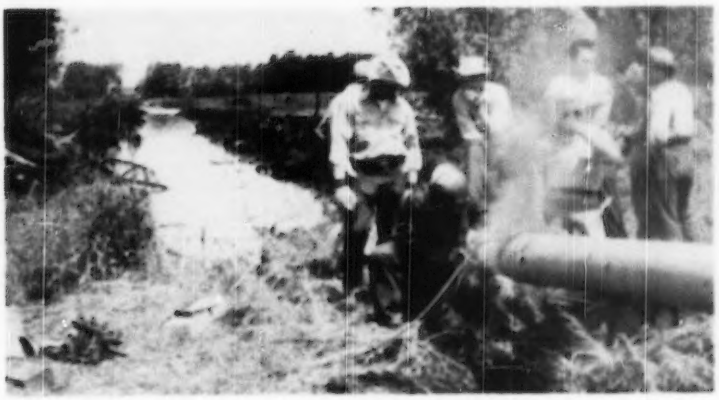


SUBMARINE BLASTING: A blast of 28,000 lbs. of 60% Gelatin Extra dynamite opened a trench 2,640 ft. long and 6 ft. deep in the bottom of the lake.

A DIFFICULT PIPE-LINE RIVER CROSSING

Skillful use of explosives speeds the laying of 5,820 ft. of 10-in. pipe across Lake Butte des Morts in Wisconsin.

PHILIP R. HAMMOND*

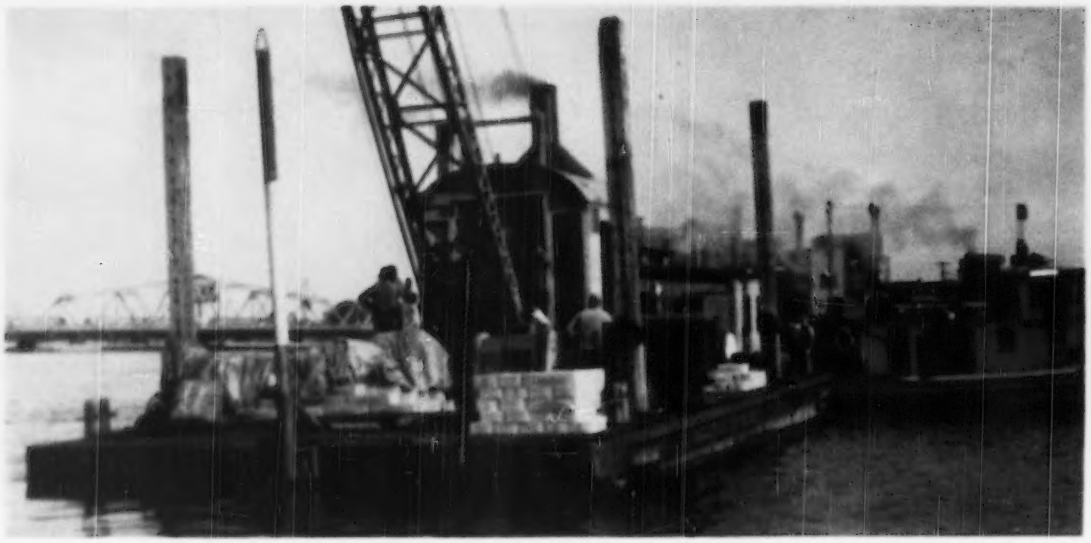


WELDING PIPE SECTIONS: A welder makes pipe ready for laying in the ditch blasted through the swamp on the south side of the lake.

A pipe-line river crossing involving unusual features has recently been completed successfully at Lake Butte des Morts near Oshkosh, Wisconsin, by the contracting firm of G. G. Griffis, Inc., for the owner, Michigan-Wisconsin Pipe Line Company. Engineering and inspection service on the project was supplied by Ford, Bacon and Davis, Incorporated. The lake crossing is part of a 197½-mile pipe line being laid by the Griffis Company from Green Bay, Wisconsin, to Milwaukee, to supply natural gas to adjacent territory.

Lake Butte des Morts is part of a river system, with a current of 3 miles

*Hercules Powder Company, Wilmington, Delaware.



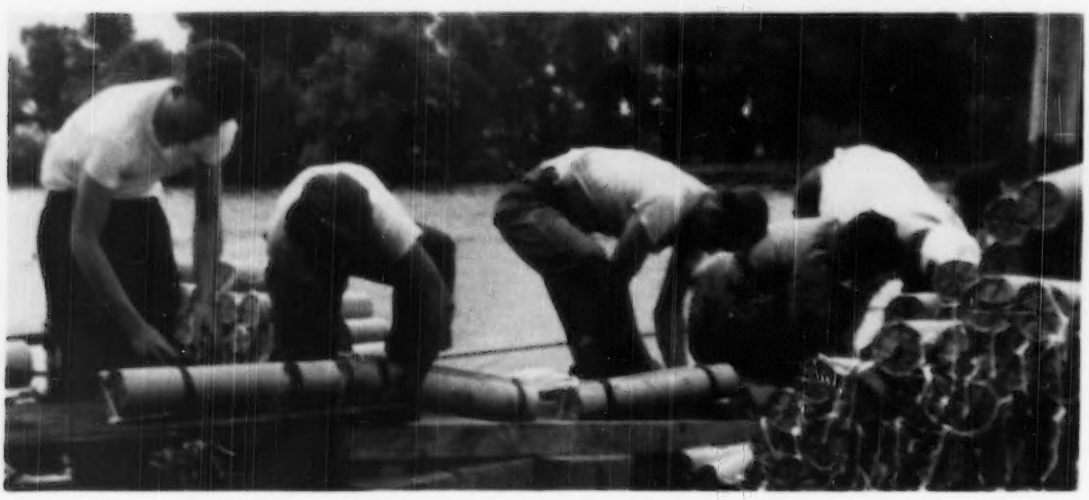
THE BARGE. During the crossing, the barge was kept moving in a straight line by a shore-to-shore cable.

an hour, which was formerly used to float logs down to bull pens located a short distance below the crossing line.

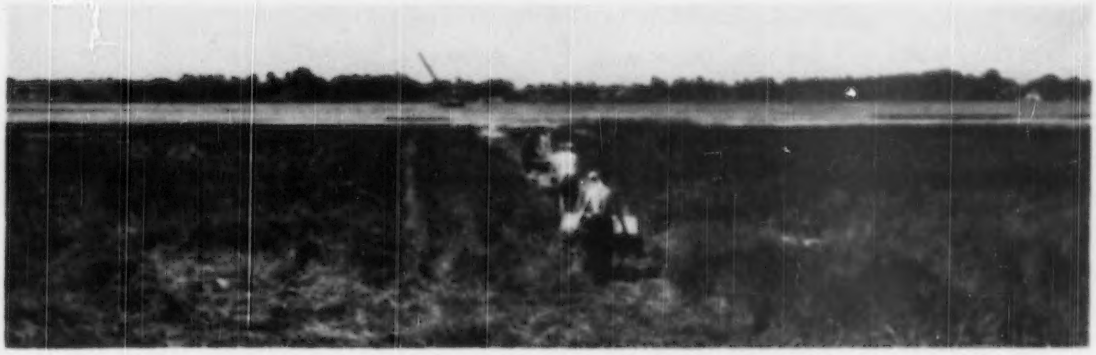
The actual width of the lake at the crossing line is 3,720 ft., but because the shores are swampy, it was necessary to blast 1,300 ft. of ditch through swamp on the south side and 800 ft. on the north side, making the total length blasted 5,820 ft.

In planning the work, residents long familiar with the lake were consulted in the hope of anticipating the difficulties to be overcome. However, local testimony proved somewhat unreliable. It was generally predicted that sunken logs would be encountered along the line of the crossing. Careful soundings disproved this. It was also stated that the lake is nearly always calm, especially at night and during the first few hours of daylight. However, once the work got under way, the wind blew continuously until the last blast was fired. After that, the local weather prophets were justified—flat calm prevailed.

A professional diver of the neighborhood gave information that could not be doubted. He said that during the depression, while he was working the lake for sunken logs in the vicinity of the bull pens, he had found the bottom in the channel so soft that he was unable to walk on it and was forced to crawl and swim. He had to feel his



PREPARING SUBMARINE CHARGES. Men on the barge placed nine cartridges of dynamite end to end on the workbench, 4 in. apart, then tied and taped them to the cable and the Primacord.



WOODEN RAFTS. Workmen hauling navy-surplus balsa wood rafts, 4 x 6 ft., to the swamp area to make working platforms for the ditch blasting crew.

way because the water was so murky that in his diving gear he could see only a few inches. This meant that any mistakes made in stringing the dynamite cartridges would be difficult, if not impossible, to correct.

Equipment and Supplies

The material assembled to do the job consisted of a barge, 60 by 28 ft., on which was mounted a steam dragline with a 1½-cu. yd. clamshell bucket; 4,500 ft. of ¾-in. steel cable; 4,600 ft. of ¾-in. plow steel cable; 1 Steelcraft motor launch; 1 outboard motor boat; 1 deadman (heavy pipe to be buried 10 ft. underground, equipped with sheaves for tightening cable); 1 HD tractor; about 60 navy-surplus balsa wood life rafts, 4 by 6 ft.; 1,000 ft. of ¾-in. Manila rope; 10,000 ft. of friction tape; 2 rafts, 12 by 12 ft.; 5 punch bars, 1¾ in., for making holes in swamp; 40,400 lbs. of Hercules* 60% Gelatin Extra, in 5-in. by 25-lb. cartridges; 3,900 lbs. of ditching dynamite, in 1¾ by 8-in. cartridges; and No. 6 Electric Blasting Caps for detonating the Primacord.

The contract specified that the pipe must be at least 6 ft. below the bed of the lake. The pipe is 10 in., inside diameter, with walls ¾ in. thick. Enough pipe for the lake crossing was welded into 210-ft. sections in parallel rows on the north bank.

The bottom of the lake is composed of varying material. About 1,000 ft. out from the north side, there is a man-made rock pile, and between this and the shore, the bottom is a hard, sticky, black gumbo. There are about 1,600 ft. of soft, black gumbo in the channel and about 1,100 ft. of a rather hard, gravelly material on the south side of the lake. The lake is roughly 10 ft. deep in the channel, and the shores slope from the banks to a depth of about 6 ft. before dropping off to the 10-ft. depth.

The first test blast was made in about 6 ft. of water on the south side of the lake near where the depth drops from 6 ft. to 10 ft. in the hard, gravelly bottom, which seemed to be the toughest material to move. Hercules 60% Gelatin Extra, in 5-in. by 25-lb. cartridges, was laid end to end and tied to a ¾-in. plow steel cable and to a line of Primacord. This test blast, 72 ft. long, was fired with 1,000 lbs. of explosives. It produced a ditch of

WORKING IN THE SWAMP. Some of the crew, working from wooden platforms, make preparations for blasting a ditch in the swamp by the propagation method.

*Reg. U. S. Pat. Off.

ANOTHER BLAST: The detonation of 14,200 lbs. of dynamite blasted a ditch 1,880 ft. long in the swamp and lake. The black material is swamp muck.

a depth that met job specifications.

Another test blast was made in the swampy material on the ditch line approaching the south side of the lake. Hercules 50% N.G. (ditching dynamite) was used for this. Individual charges of four 1¼ by 8-in. cartridges were placed in holes 42 in. deep, on 18-in. centers, and fired by the propagation method. This resulted in a ditch 5 ft. deep. It was decided to use a little heavier charge for subsequent blasting in this material.

Preparations for Blasting

A ⅝-in. steel cable was made fast to a group of trees on the south shore of the lake. The cable was then run through guides on the barge to the opposite shore, and through sheaves anchored to the deadman. The slack was taken up and the cable was kept taut by the HD tractor. The cable kept the barge in a straight line as it was moved across the lake by dropping the dragline bucket off the northeast corner and then swinging the boom to the right. This maneuver moved the barge about 21 ft.

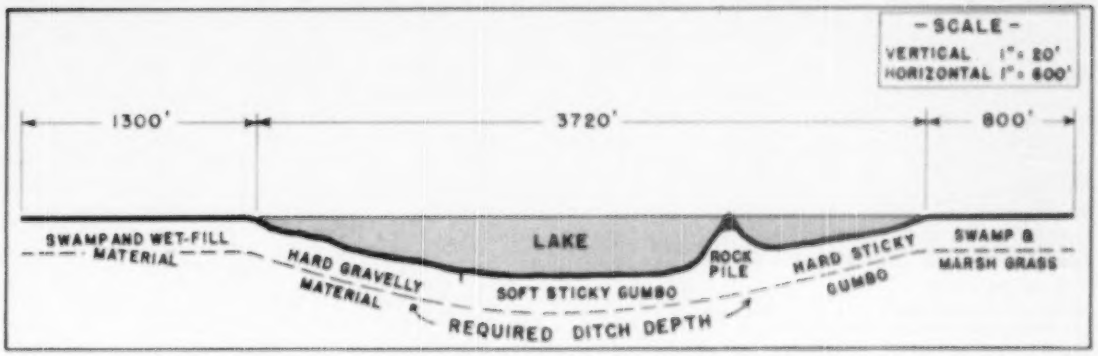
A workbench 22 ft. long, called the powder table, was set up on the after-end of the barge. In line with this bench and forward of it were two racks, one housing a 4,600-ft. spool of ⅝-in. plow steel cable, and the other housing 1,000-ft. spools of plastic-covered Primacord. The cable and the Primacord were anchored to trees on the south bank. The crew consisted of 1 dragline operator, 1 oiler, 9 men on the powder table, 2 men to guide the powder down a chute to the lake bed, 2 men opening powder boxes, and 1 expeditor on the Steelcraft.

The 5-in. by 23-lb. cartridges of 60% Gelatin Extra were laid end to end on the workbench, 4-in. apart. Extra-long tie strings and friction tape were used to fasten the cartridges to the cable and the Primacord. An extra loop of Primacord was tied around every sixteenth cartridge and back to the main Primacord line. When nine cartridges were taped and tied, the barge was pulled along the cable 21 ft. by swinging the dragline boom, and the operation was then repeated.

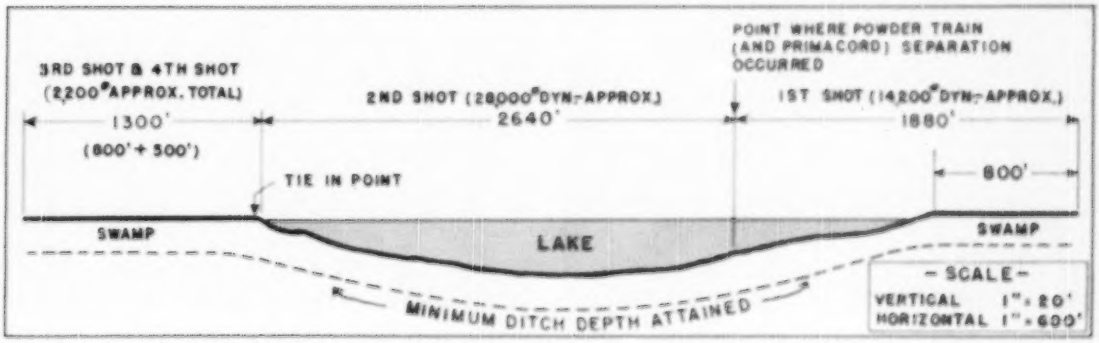
After progressing about 750 ft., the wind became so strong that work was stopped until 6 a.m. of the following day. The rate of advance was approximately 400 ft. an hour. When the barge reached the rock pile on the north side of the lake, the grousers—heavy, pointed timbers located at each corner of the barge and sliding vertically—were dropped, and the rocks were clammed out. However, because

(Continued on page 159)

AS PER SPECIFICATIONS: The blast pictured on opposite page made a clean ditch 7 ft. deep through the swamp on the north side of the lake.



BEFORE BLASTING: Profile of Lake Butte des Morts based on soundings made before blasting.



AFTER BLASTING: A profile of the lake area after blasting operations had been completed.

PREPARING TO BLAST: The shot fireman connects the leg wires of an electric blasting cap with the shooting cable, preparatory to firing a charge of permissible powder in one of the stub holes.

ROOF SUPPORT: Workmen using electric drills install roof bolts in the roof of a working place. Where the top tends to break out between the bolts, 2-in. by 6-in. by 14-ft. boards are used.

CUTTING A FACE: A Goodman 2924 slabbing machine, equipped with a 9-ft. cutter bar and throw-away bits, is used to cut a working face.

ISLAND CREEK'S MINE No. 27 AT SCARLET, WEST VIRGINIA

DUSTING THE KERF: A man with a long-handled bugduster removes machine cuttings from the kerf. The importance of removing the greater part of the dust from under the cut is constantly stressed.

DRILLING IN A FACE: An operator drills one of four holes in the top of the face. Each hole, approximately 2 in. in diameter and 8 ft. deep, is loaded with three cartridges of permissible powder.

A Review of Operations at Island Creek Coal Company's Latest Underground Mine Development.

NICHOLAS T. CAMICIA*

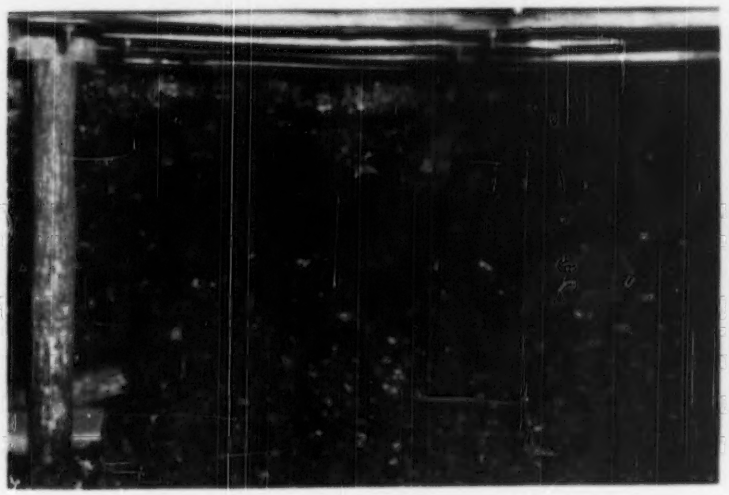
ISLAND CREEK COAL COMPANY owns and operates a group of 11 mines in the high-quality bituminous-coal fields of Logan and Mingo Counties, in southern West Virginia. All phases of mine operations are coordinated and controlled from a centrally located main office at Holden, West Virginia.

Beginning at Holden in 1901, the company pioneered in coal mining in southern West Virginia, operating under the name of United States Coal & Oil Company. Since that time, the original operating company and its successor, Island Creek Coal Company, have been leaders in the recovery and the preparation of quality coals, utilizing the most up-to-date equipment available to the industry.

During recent years, the Island Creek Coal Company has expanded its mining and plant facilities considerably to meet a growing demand for high-quality coals. The latest development in this modernization program is Mine No. 27, located at Scarlet, Mingo County, West Virginia.

The mine was opened in 1949, and the first railroad cars of coal were loaded from a new preparation plant in April of that year and hauled over a Chesapeake and Ohio Railroad line built especially for the new Mine No. 27. The C&O had constructed a 2,876-ft. tunnel through Trace Mountain, in order to take care of the coal business from this territory.

The new mine is located in a narrow valley, surrounded by heavily wooded mountains. Operations are carried on in the lower Thacker coal seam of the Kanawha series. The overburden in this area ranges from 150 ft. to 1,200 ft. The coal seam is free of partings and varies in height from 40 in. to 65 in. The hard slate bottom is fairly level. In some places, the top is a solid sandstone but most of it consists of a blue slate and a sub-sandstone, extremely difficult to support. The West Virginia Department of Mines classifies the mine as gaseous, but only a small per cent of methane is liberated.



BLASTING RESULTS: The excellent results obtained are evident in the above picture, with its abundance of the larger sizes of coal. This kind of face preparation speeds loading operations.

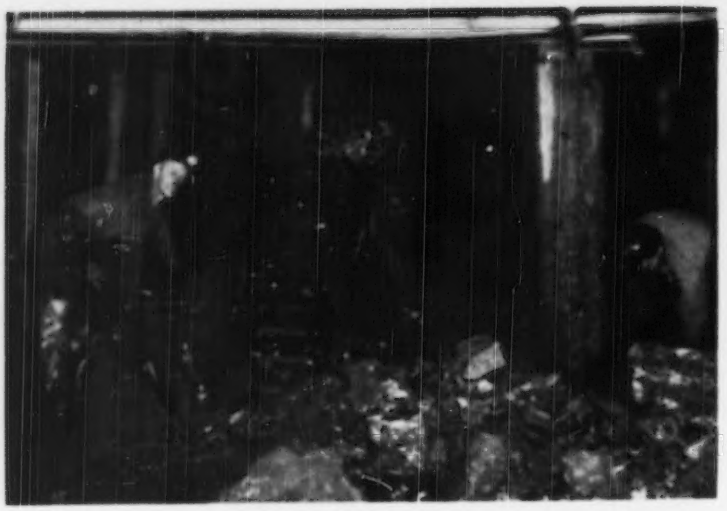
Industrial Engineering Department

To produce safely the maximum tonnage of high-quality coal with the greatest efficiency and a minimum of cost, Island Creek Coal Company established an Industrial Engineering Department several years ago. This department has proved to be so successful, especially in recent years, that it now supervises all phases of operations. From analyses of time studies, standard methods and practices are established for every work cycle. Cost budgets are prepared by this department to meet the requirements of a particular mine. The Industrial Engineering Department works very closely with the Operating Department personnel, always available to help in the solution of any problem and constantly encouraging the operators to obtain maximum efficiency at the lowest possible cost. The work cycle described briefly below was adopted as standard practice by the Operating Department after numerous time studies and analytical work had been completed by the industrial engineers.

In a typical working face, the work cycle consists of supporting the roof by eight 1 by 48-in. wedge-type roof bolts and four posts per cut, in addition to two safety posts. On most sections, drilling the holes for the bolts is accomplished by means of a Cleveland stoper, using Timken drill steel and bits. Air is furnished by a stationary Joy compressor located at the portal, and is carried to the sections through 3-in. iron pipe. Other sections are drilled by the employment of electric rotary drills. Where the top tends to break out between the bolts, a 2-in. by 6-in. by 14-ft. board, with holes already drilled for bolts, is used. The number of bolts installed varies from 6 to 12 per cut, depending on the type of roof encountered. The height of the coal determines the length of bolt installed, the maximum length being used in every case.

After the working face has been properly timbered, rock dust is scattered by hand back of the face, and the cutting machine is moved into the place. A Goodman, type 2924, slabbing machine, equipped with a 9-ft. cutter bar and Goodman throw-away bits, is used. Mounted on half tracks, this

*Division Superintendent, Island Creek Coal Company, Holden, West Virginia.



LOADING THE COAL: A 14-BU Joy 7AE loader begins operations on a fresh cut. Roof bolts and headers, in addition to a line of posts, afford excellent roof support for the crew.

LOADING A SHUTTLE CAR: A close-up of a loader operation with a Joy 6-SC shuttle car in position to receive coal. Close teamwork between the two operators is required.

rugged machine is easily maneuvered. The cutter crew completes its cut in a few minutes and then trams to the next working place.

To obtain the best prepared sizes, special attention is given to the next operation—dusting the kerf. This is done by a man using an ordinary long-handled bug-dust shovel. The importance of shoveling the greater part of the dust from under the cut is constantly impressed upon the bugduster. He is often reminded that his job is the key operation to good face preparation, which will not only give better sizes but also will decrease the amount of explosives necessary to blast the cut, and provide easier digging and loading of the blasted material for the loading machine crew.

Drilling, Blasting, Excavating

A cat-mounted drill consisting of a Jeffrey 56-A drill arm, mounted on a Joy T-2 truck, follows immediately into the face. The undercut is first measured to determine the depth and placement of the drill holes. After stamping his hole, the operator aligns his drill arm and places the starter auger in position to drill. A 5-ft. starter hole is first drilled, then a 9-ft. auger is used to complete the hole, usually about 2 in. in diameter and 8 ft. in depth. Upon completion of each hole, it is thoroughly cleaned of drill dust. Special care is taken by the drill operator to see that he does not drill into the roof or into the solid coal on the sides or back of the cut. Coalmaster augers and diamond-point bits are used.

As soon as the drill has moved into the next place, the shot fireman comes into the face. After examining the top carefully and testing for gas, he checks to see if the cut is properly dusted and then measures the depth of each hole in relation to the depth of the undercut. The required supplies of permissible powder, electric blasting caps, and stemming are then brought up, and the holes are loaded and tamped with clay dummies. Only one hole is loaded and fired at a time.

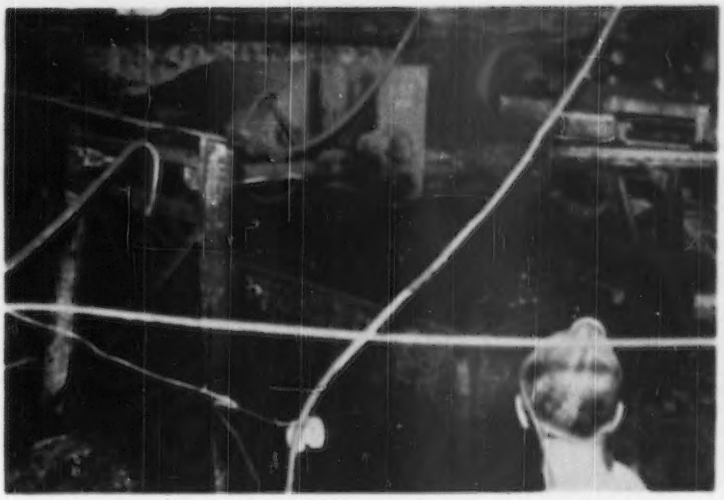
The average face is drilled with 6 holes, 4 across the top of the face and 2 snub holes near the bottom. The snub holes are fired first. About 16 cartridges of permissible powder are used per cut—3 cartridges in each top hole and 2 cartridges in each snub

hole. The primer, an electric detonator, is fired with a permissible battery. Hercules Red H*F permissible powder, in 1¼ by 6-in. cartridges, is used. For blasting rock, Hercogel*2, in 1¼ by 8-in. cartridges, is used. In an average blast, the explosives loading ratio is 1 lb. of powder to 4.8 tons of material. The average blast produces coal sizes as follows:

5 in.,	8.0%
5 by 3 in.,	13.0%
3 by 2 in.,	14.0%
2 by 1¼ in.,	15.0%
1¼ by ¾ in.,	32.0%
¾ in. by 0,	18.0%

A 14-BU Joy 7AE loading machine has no difficulty in loading the broken coal from a blast into the two Joy 6-SC cable-reel shuttle cars serving it. Each shuttle car carries a load of about 3½ tons of material which is dumped into a Joy P-L12 feeder elevator. The feeder serves as a hopper and dumps an even flow of coal onto a Joy 30-in. belt which conveys it to the loading point, where a boom car loader, attached to the belt head, distributes the coal evenly into 5-ton mine cars.

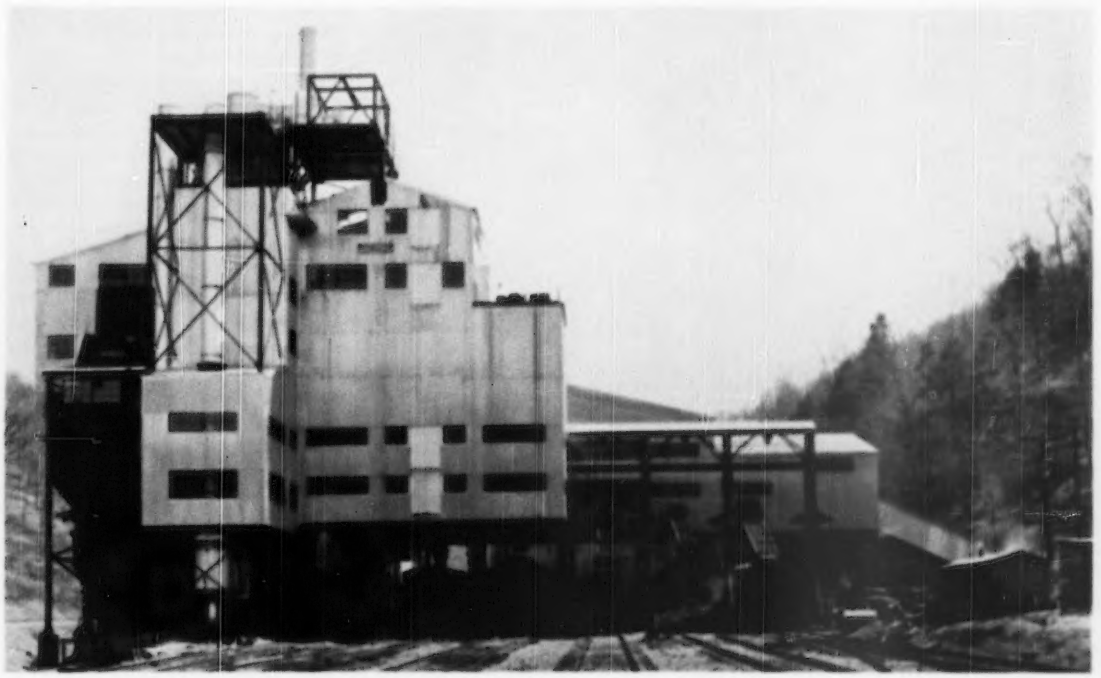
*Reg. U. S. Pat. Off.



BOOM CAR LOADER: Coal is discharged from a Joy 30-in. belt line onto a boom car loader which loads cars evenly and permits car change without spillage or loss of time.

Loop tracks at the loading booms are serviced by 6-ton Jeffrey gathering motors that place their loads on and receive their empties from sidetracks. The loaded cars are picked up from the sidetracks by 15-ton Jeffrey haulage motors in tandem and taken to the bottom where the cars are placed on a chain haul. Here a crew weighs, dumps, and records each car. The empty cars are picked up by the same haulage motors and returned to the sectional sidetracks.

(Continued on page 160)



PREPARATION PLANT: This modern preparation plant is constructed of steel and concrete with aluminum siding. It was designed and erected by Roberts and Schaefer Company of Chicago.

TCI'S DOLONAH QUARRY HONORED FOR SAFETY ACHIEVEMENTS

Sentinels of Safey trophy and flag awarded to Bessemer, Alabama, operation.

"CONGRATULATIONS": J. I. Horty, managing editor, The Explosives Engineer, awards the trophy to Superintendent G. B. Neal, Jr. At right, R. E. Towers, general quarry foreman.

With a record of 285,223 man-hours of work without a lost-time injury in 1949, Tennessee Coal, Iron and Railroad Company's Dolonah quarry, Bessemer, Alabama, was the winner of the Sentinels of Safety trophy in the quarry group, in the National Safety Competition of 1949, conducted by the U. S. Bureau of Mines. Company officials, employes, and guests met together at the quarry property on August 2, to participate in ceremonies honoring the winning quarrymen.

Adolph Beck, general superintendent of TCI's ore mines and quarries, was master of ceremonies. After extending congratulations to the Dolonah employes for their splendid achievement in safety last year, Mr. Beck said, "Your record of no lost-time accidents during more than 285,000 man-hours of work during 1949, and your injury-free operations in six other years, did not just happen. They were accomplished by hard work and good planning on the part of your foremen and you workmen, cooperating as a team with the company's safety bureau, to make Dolonah quarry a safe place to work. May your record in the year 1949 be the inspiration for even greater success in accident prevention in future years."

At the conclusion of his remarks, Mr. Beck introduced several company officials and guests, among whom were: A. V. Wiebel, vice president; R. E. Kirk, manager, raw materials; J. C. Gray, assistant manager, raw materials; R. H. Bumgardner, manager, safety bureau; and R. W. McKee, manager, Birmingham district, Hercules Powder Company.

J. I. Horty, managing editor of The Explosives Engineer, was then introduced by Mr. Beck. "It's good to be back in Alabama," he said, "to again award the Sentinels of Safety trophy to the men of Dolonah quarry for having had the best record in safety in the quarry group in the 1949 National Safety Competition. I had the privilege of awarding the trophy to you fellows two years ago, when you were the winners in the 1947 contest. And I am very happy to make the award of the trophy to you today, for your winning record in 1949."

After extending his congratulations, and those of his associates, to each

THE SPEAKERS: Left to right, A. V. Wiebel, the Tennessee Company's vice president; B. E. Kirk, manager, raw materials; Mr. Horty; Mr. Neal; M. C. McCall, U. S. Bureau of Mines; J. C. Gray, assistant manager, raw materials; A. W. Beck, general superintendent, ore mines and quarries; and A. F. Harper, chief inspector, State of Alabama.

man in the Dolonah quarry organization, Mr. Horty reviewed the 25-year history of the National Safety Competition. "In the first contest 25 years ago, there were 200 plants enrolled. None of them worked through the year 1925 without a lost-time accident. In 1949, there were 646 mines and quarries participating, and 202 of them did not have a single lost-time accident. That's a record of progress in safety promotion of which we all can be proud."

Continuing, Mr. Horty said that 261 quarries, located in all sections of the country, representing a total work-time of 21,500,000 man-hours, were enrolled in the 1949 National Safety Competition. Of these 261 quarries, 139 reported no lost-time accidents. "But your record of 285,223 man-hours," said the speaker, "was the best record of them all."

Explaining the significance of the trophy—a mother with her baby in her arms reaching out to welcome the father on his safe return home from his work in the quarry—Mr. Horty asked the Dolonah workmen to keep that picture before them, in their mind's eye. "It will help to stop you," he said, "when you feel like taking a chance in this fast-moving world of today."

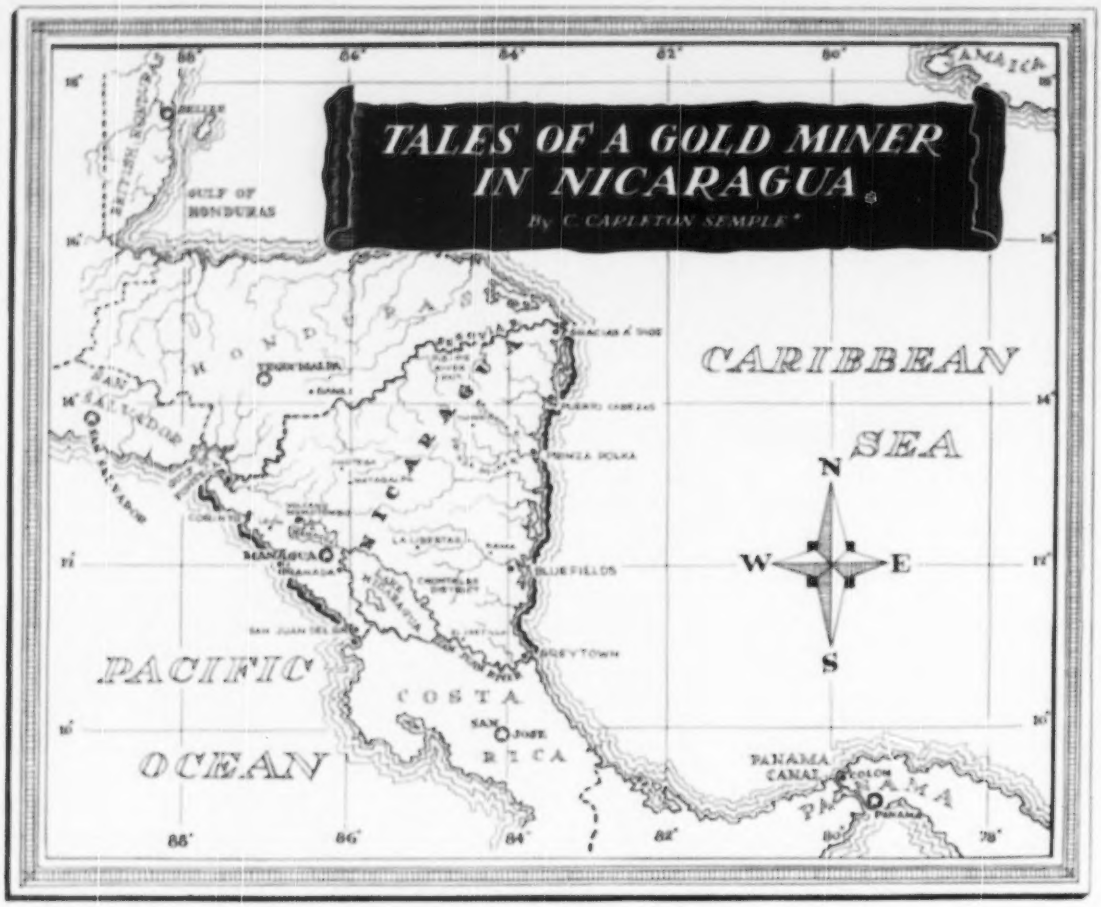
In addition to the bronze trophy, the speaker presented a Sentinels of Safety flag to the winning quarrymen.

In accepting the trophy and flag on behalf of his quarry associates, Superintendent G. B. Neal, Jr., expressed his pride in Dolonah quarry's receiving this coveted honor. "We will do our best," he said, "to win the Sentinels of Safety award again in 1950."

M. C. McCall, chief, Accident Prevention and Health Division, Region 7, U. S. Bureau of Mines, was introduced by Mr. Beck. Mr. McCall congratulated the winners and expressed his appreciation for their repeated successful efforts in achieving national recognition in the field of safety. He then presented the Joseph A. Holmes Safety Association Award and Certificates of Achievement in Safety to each employe in the Dolonah quarry group.

Mr. Beck then called upon A. F. Harper, chief, Division of Safety and Inspection, State of Alabama, who expressed his pleasure at being present on this happy occasion. He extended congratulations to the mangement, supervisory force, and each employe of the Tennessee Company, for consistently splendid safety records. In conclusion, Mr. Harper said, "We want to come back again next year to celebrate another victory over accidents in the operation of Dolonah quarry."

THE WINNERS: The employes of Dolonah quarry worked 285,223 man-hours in 1949 without a lost-time injury.



Some rambling recollections of mining operations under peacetime and wartime adversities.

PART I

This writing started out to be a serious account of how a small gold mine in Nicaragua was operated during the war. To the profession, articles about mines and ores are interesting, and make instructive reading. However, the people met with in line of duty often are more interesting and can present problems less easy to solve than technical ones—at times more amusing or more annoying. In writing this little saga, recollections come back of other events at other mines in other climes. If these are amusing in their relation, I shall not hesitate to set them down. "Don't fence me in."

As a youngster, no thought of seeing a mine ever entered into my plans. All my preparations had been for a career as a chemist. Then Theodor Weicker came over from Germany as manager for Merck & Company, and he told my folks that for an American boy to choose such a career was a mistake. He always would be able to bring over from Germany, for $75 a month, all the chemists America would ever need. The family thought it over and I switched from chemistry to metallurgy.

Weicker taught me another lesson that applied to mines which I have never had reason to regret. He bought a place in Stamford, Connecticut, and my folks had the job of furnishing the stable, from horses to grooms and equipment. Their ideas ran along Martin & Martin lines, which he checked by suddenly buying, at a bargain price, a deceased neighbor's outfit. It was my job to clean harness. By the time dried-out carriage wheel spokes and broken straps had been mended, and missing buckles replaced,

*Director, Empresa Zopel. Apartado 552, San Jose, Costa Rica.

a "bunch of junk" had cost more than the best of new equipment. Ever after to me, as the English express it, "if it's cheap, it's nasty."

Quality Merchandise

Once upon a time Louis Stoddard had a great, double-breasted coaching or polo coat made for him by Aquascutum. He gave it to a friend who passed it on to me. For twenty years in Alaska, Peru, Bolivia, Northern Chile, and the Argentine, although about four times too big for me, it kept out the rain, wind, and snow, and kept my mule and saddle bags dry. At times it served not only as a bed or a blanket but a waterproof cache for my equipment. Finally, it ended up back in England for further use by a ninety-year-old man who wanted to be buried in it. It still bore all the original buttons.

While on a trip to England I blew myself, extravagantly I thought at the time, to several woolen shirts made from wool taffeta, a material apparently unknown in New York until World War II broke out. The shirts were warm in winter and the most comfortable ones I ever wore during a New York summer. They contained so much natural oil that they were, to a degree, waterproof. Hang them on a coat hanger to air for a few days and every crease and wrinkle would disappear. For travel, one did not need a laundress, nor did those one traveled with think so. I've still got some of the shirts bought twenty years ago. So it is with mining equipment. Get good stuff and no matter what happens to it you can repair it. In many countries such as Central America, it will not become obsolete in a lifetime, as most of us learned during the war.

At one time, while carrying on smelting operations at the old Ore Knob mine in North Carolina, I used a compressor installed during the incumbency of Dr. James Douglas and T. Sterry Hunt. Of course, it wasn't economical of steam, but it was the one thing on the job to which no one ever gave a second thought. How close we came that summer to being codiscoverers of basic and neutral linings for copper converters, right at the time Peirce and Smith were putting it over in Baltimore! As one London tailor expressed it, "the satisfaction continues long after the price is forgotten." One mining engineer of my acquaintance still wears on trips the cap he wore playing baseball at school. But he still persists in trying to beat the dollar when it comes to buying machinery.

Nicaragua has always produced gold but the amount was never a considerable portion of its export values until the early 1940's, when the total production exceeded in value that of coffee and all other products. The country never has had an extensive banana industry. At one time, there were ambitious projects for the exportation of longleaf yellow pine, of which Nicaragua has about the largest remaining stand. Also, it was proposed to establish a pineapple industry at Pearl Lagoon along the lines that the pineapple king, James Dole, was carrying on in Hawaii. Pearl Lagoon just could not compete.

EARLY IN LIFE: As a boy, I had to repair and clean broken-down harness. From then on, I became a staunch advocate of quality materials and equipment.

When, after Pearl Harbor, it became doubtful about being able to transport coffee, the United States Government considered that it might be advantageous to all concerned to allow the Nicaraguan gold mines to continue operations throughout the war. Guy N. Bjorge, of the Homestake mine, was sent to find out the facts. Permission was granted to the mines for priority on the minimum quantity of essential supplies. No development work of any kind was to be done, other than the minimum required to keep known ore supplies available in order to keep the mills running.

Observant Indians

A story used to be heard frequently in Mexico that the conquistadores discovered every outcropping of a true fissure vein in Latin America. I doubt that they were the real discoverers of any. The native Indians are observant, quick to perceive the extraordinary and the unusual. In South American mining countries, the llama was the only beast of burden. A stone thrown from a sling was one way of bringing an errant llama back on the trail. It also was, and still is, a custom that when crossing a high mountain ridge to place a stone on a pile at the very summit. In order to leave a record of whence came the depositor, stones were often carried for miles, or even from the home town for this purpose, especially if on the way any characteristic stones happened to occur. In Central America there were no beasts of burden. The Indians thus had their attention focused on stones in general, and any unusual stone in particular. I think every vein was originally found in that way.

The discovery of the greatest of all mines, up until this current century, was made in a somewhat different manner, but a stray llama was the cause of it all. In 1545, an Indian, while hunting for a stray llama was overtaken by darkness. He built a fire against a boulder to keep off the chill of the night. When daylight came, he noticed that the fire had melted some of those easily reduced minerals of silver into a sizable button. And so Potosi was found in Bolivia. It became the greatest silver producer of all time and is still being worked for tins and silver by Mauricio Hochschold's enterprises. Of course, this story spread and one hears it applied today to the discovery of mines even in Arizona.

So, it might be said that the mineral veins have always been known, at least in Latin America. In Nicaragua, the earliest accounts of the workings of deposits do not date back before the first quarter of the nineteenth century. In the 1840's, Thomas Belt, an Englishman, was manager of an English com-

pany that operated a mine known today as the Jabali Company, in the Chontales district just east of Lake Nicaragua. Operations at Jabali have been going on almost without interruption ever since. Belt is best remembered as the author of a book, *A Naturalist in Nicaragua*, one of the Everyman's library series. Charles Butters, William Mein, and Thomas Pullinger came to Jabali from the Rand, and parts of the mill they built are still there. They also had interests in smaller mines about 10 miles farther east, nearer the lake, just outside the town of La Libertad. They operated a silver mine known as the Grecia, east of Leon, not far from the currently operated mines of La India and Limon.

San Albino Mine

Butters went farther north into El Salvador where, in the southeastern tip of that country, he had a part in nearly every one of a considerable number of mines, all being worked today. Some of them were taken up by New York-Honduras Rosario at the close of the recent war. Butters is reported to have done particularly well at one of these mines, the San Sebastian. He came back again to Nicaragua and opened up the San Albino, in the Department of Nueva Segovia, on a belt that seems to extend south all the way from the Auga Fria mine near Danli, in Honduras. When the first production was about ready for shipment Sandino happened along, took over, and blew up the mine. Remarking that Butters had always played fair with him, he let him get away without personal injury. That episode is said to have broken Butters financially and spiritually—the story goes that he died in San Francisco within the year or so. Charles Jannin, of San Francisco, had the mine examined for Canadian interests as soon as Sandino no longer continued a menace. However, the mine has never been reopened and now is the property of the chief proprietor of Nicaragua. During the war years, soldiers and road builders frequently brought to me small quantities of gold from the region, some $5,000 worth in the course of five years. It was obviously placer gold, which is produced from most of the small creeks thereabout. This fact, together with the mine being on the Danli belt, made me desirous of a thorough study of the region as a whole. But every attempt to make a visit has run up against obstacles. I have been told that the San Albino ore in particular is extraordinarily spotty, and that the gold occurs in abundant sulfides so that treatment, apparently, would call for flotation. Reports come in of a whole series of veins over a long belt, and every stream carries some placer. The branch bank managers report having bought a small trickle of production over many years.

THE DISCOVERY OF POTOSI. A fire built by an Indian against a boulder melted some of the easily reduced minerals of silver into a sizable button.

During most of the nineteenth century, the east coast of Nicaragua was almost like a separate country, in fact, there were English claims to it. Lord Nelson fought an engagement on the San Juan River at El Castillo. However, it was not in that assault that he lost an eye or an arm, as is sometimes told. The region embraces all the coast from Greytown north, through four degrees of latitude to Cape Gracias, averaging a little more than a degree of longitude in width, and a north and south coast line. It includes some 72,000 sq. kil. in area, or a bit more than all the rest of the country, excluding the areas of the two lakes. Its population is about one per square kilometer. Now known as the Department of Zelaya, it is still marked on many maps as the Miskito Coast, or at least it should be. It takes its name from the principal of the three or more tribes of Indians who inhabit it, and not from any insect.

The Miskitos

Its two towns are Bluefields and Rama. The first is a port on a shallow lagoon where the river Escondido meets the sea. It derives its name from the pirate, Blauveldt, who hid in the bayous of the delta, too intricate a network for any British frigate to find him. Hence, the name of the river, which means hidden. What bananas Nicaragua has produced came from this region. It was the locale of operations of the George D. Emery Lumber Company that cut and shipped mahogany from the coast for many years. Cruisers for the lumber company found the Sumu Indians using gold nuggets for sinkers. The pitpans, or dugout canoes, large enough to accommodate two persons, are manned by the Miskitos. These natives are huge from the waist up, built for paddling 24 hours at a stretch the first day out, and not much rest the following days, going up the rivers. They were so honest that there never was any difficulty about insuring the gold that one turned over to them at the mines to take downriver to the coast. The only requirement was that a tightly soldered tin buoy be attached to a 30-ft. cord, with the other end fastened to the bar. Once in a while a pitpan turned over, and several days elapsed with production lying in the bottom of the river. But there never was a loss over several decades.

A story is told that one of these lumber company cruisers used to pay the

Sumus a shilling for a condensed milk tin of nuggets, and for diversion he prospected for veins instead of trees. One of these individuals named Schultz is credited with having found the first mine, the Siempre Viva, in the Pis-Pis River district. Paul Reyner followed with Concordia and Constancia. Joe Lapierre with Bonanza, Sherrick with the Mars, "Uncle" Billy Bluett and McDonald with Lone Star, José Aramburu with La Luz y Los Angeles, and Richard Parker with Santa Rita—the last two in the Prinzapolka and Banbana River districts, respectively. On Oconwas Creek, Frank York had a 2-in. vein of calcite, lousy with flecks of gold. Nick Martin and his brother had another vein, down south near Rama Adolfo Diaz. Some others had interests in a mine called the Topaz. The Jamaican storekeeper at Tunky was another owner, as was Old Man Pence. But they just had what the little boy shot at.

Siempre Viva and Topaz were owned and operated by companies organized in New Orleans; the others were operated by the discoverers and owners. Siempre Viva, Lone Star, Constancia, and Concordia had stamp mills; the first two had enough stamps for a fair daily tonnage, together with cyanide sand leaching plants for avoiding slimming—a problem in those days. At that time Dorr was just a fellow we read about somewhere up in South Dakota, getting frozen up in winter. All the rest had soft ores and 3½- or 5-ft. Huntington mills, with amalgamation plates, or blanket strakes.

Entertaining a Visitor

Those were the days when Zelaya was the head man in the government. We paid 50 cents an ounce for fine gold as export tax. During his waning years, Zelaya thought he might jack this up a bit and dispatched a friend of his, Juan Leets, to investigate the whole Miskito Coast gold industry. My camp was the first one visited. In the hope that a good beer imported from the United States, if sold at cost price to the workmen, would result in less lost time than using the native cassisa as a beverage, I had a standing order for monthly shipments of eight or ten barrels, of a gross of bottles each. When Leets arrived, I had a boy follow us about all day with all the bottles of cool beer he could carry. Also, I had given instructions that the visitor be given my room, where there was a big double bed left by Parker and his wife, and a couch for the assistant, while I would sleep on a "tijera" in the office.

All went well until late after dinner when we all joined to play pedro, the then-popular card game in the country. My previous experience with beer had been somewhat limited, and I regarded it as a beverage that one would get filled to capacity with, before it would have appreciable effect. All I remember is that I hit the jack pot at pedro. And then it was morning, and I was trying to figure out how come I'm in bed with someone? Oh, what a headache! And, oh, what a line of bottles Jackson, our storekeeper from Corn Island, had to show me! After I had breakfasted on two flakes of oatmeal with two thumb tacks to keep them down, I told the messboy to take coffee to the inspector. He soon came back with the coffee and the report that there was no one in my room. And that was the last the Miskito miners ever saw or heard of Juan Leets, and the last we ever heard of an increase in export duties.

It was in the spring of 1907, at this mine, that daylight saving time was invented, as far as I have been able to find out. Our workmen were mostly Miskitos and Jamaicans, with a few Spanish woodcutters, miners, and bull drivers from Nicaragua proper, Chinandega, and Jinotega. All of them were accustomed to getting up before dawn and to start work at earliest daylight. One late afternoon, all hands began to assemble below the office, on the outside wall of which a large eight-day clock could be seen from all over camp. In those days the operators provided lodging and meals for everyone, in addition to wages. It began to look as if something were about to happen to me that had never happened before or since—I had a strike on my hands. When the spokesman came up, he reported that all they wanted was that the clock be set ahead so that when breakfast was over the seven o'clock whistle could blow and there would not be the hours of waiting before commencing work on standard time. Those were the days when Wilbur and Orville Wright were at Le Mans and our only radios were Miskitograms, messages that got from coast to mine overnight, when no one else could make the trip in less than three to five days. I never found out how the Miskitos did it, but they were always accurate. And that's how the custom began of a committee setting the clock on the first day of every month.

When World War I broke out, I was on the *Engineering & Mining Journal*. When the topic of saving fuel for lighting began to be discussed in New York papers, it was natural for me to tell about "Santa Rita" time. "Well of all

DISPENSING HOSPITALITY: A boy with a basketful of cold beer accompanied Zelaya's investigator throughout the day.

the fool suggestions. . . ." I was living in Connecticut at the time and there were those who searched their Bibles for chapter and verse, citing when Greenwich mean time was created.

Nicaraguan Mining Code

La Luz y Los Angeles was sold by Aramburu to the Fletcher Brothers of Pittsburgh; Thomas Lane Carter came over from the Transvaal to have a look at Lone Star; and Fred Bradley and Mark Requa had Albert Burch at Bonanza for a year or so. But Bradley did not like the Nicaraguan Mining Code. It has no extralateral rights and Bradley told me, "We have never gone outside the United States as yet, not

NATIVE MISKITOS. *Gold was transported from the mines downriver to the coast by Miskitos in pitpans, or dugout canoes.*

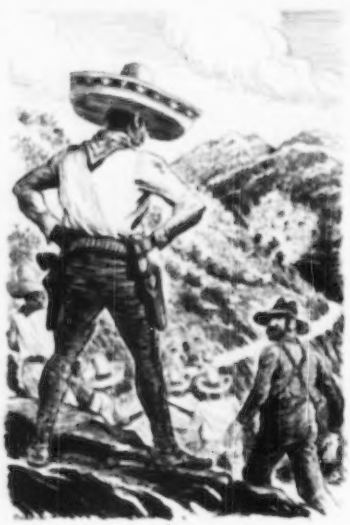
even to Mexico," where Don Porfirio was thought to be in a position to hold out forever. "I don't think we are going to change that policy now," continued Bradley, "although the sampling has shown up pretty good." His work had shown just 50 cents a ton better gold content than my own sampling—$9 a ton, pre-Roosevelt.

I recall another funny happening, at about this same time. The pitpan "captain" who brought in mail for Santa Rita was allowed a liberal selection of whatever he wanted most from the commissary. His list always began with sugar for his entire crew, and then blackstrap molasses, which I brought in like the St. Louis beer. We had one fellow who went on sprees on Perry Davis' Pain Killer. He would come from the camp on all fours to beg for another bottle. It was straight opium. But the Miskitos would take a bottle of molasses and pour it down their throats without swallowing, just like I've seen Frank Klepetko, and rarely some fellow Bohemian or Englishman, do with a bottle of beer. The Miskito would then ask that the bottle be filled again, for pouring over his rice and beans at supper.

On this day, the pitpan captain had news as well as mail—he had a passenger and his card read Sydney J. Sydney. From the captain's story, Sydney was coming to the Miskito Coast for the first time with a wife astern, and what we could only surmise was a baby grand piano amidships. He was bound for the Eden mine, one we had scarcely heard about. And that is how the Tonopah Mining Company of Nevada started in Nicaragua.

Pis-Pis Mining District

Soon after this, Zelaya blew his top and Adolfo Diaz ceased to be the affable young man representing the

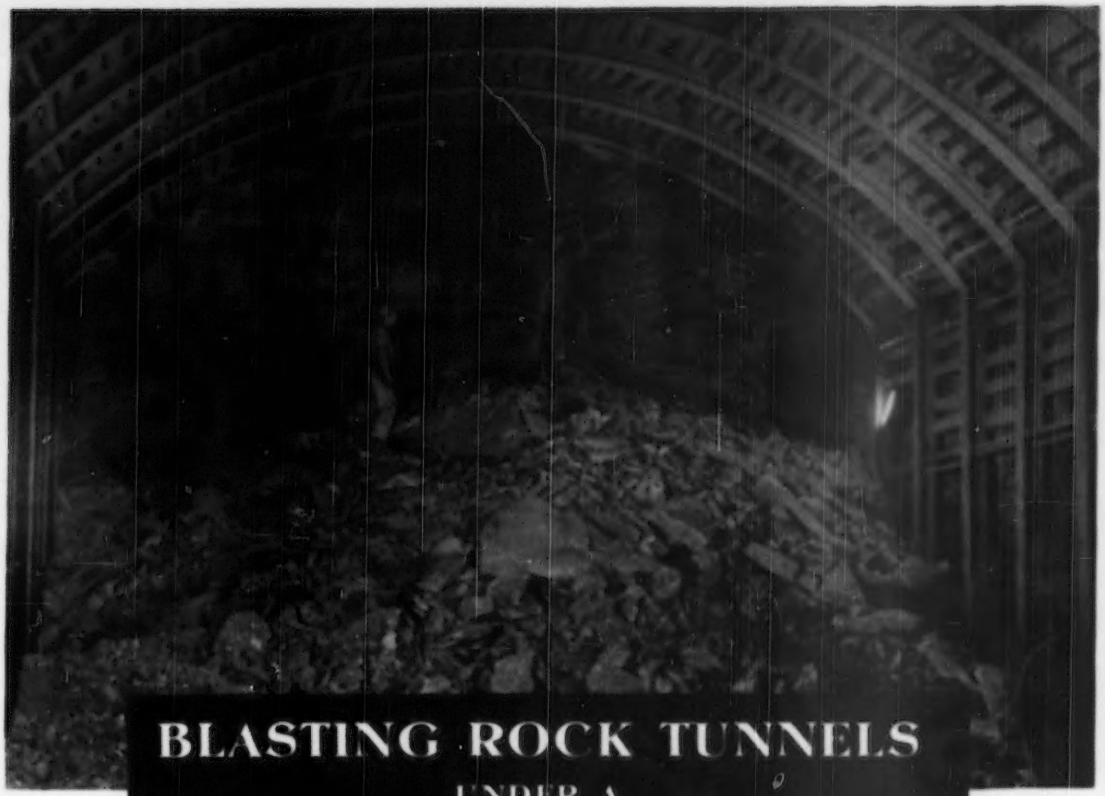


SANDINO. *When San Albino's first production was ready for shipment, Sandino took over and blew up the mine but let Butters go without personal injury.*

Rama Development Company. In time, Sandino happened along and, commencing with La Luz y Los Angeles where a new power pipe line and ditch had just been completed, he proceeded to blow the whole Pis-Pis mining district off the face of production. The next time I heard of those mines I was at the Quiruvilca copper mine in Northern Peru, and H. A. Guess asked, "What, if anything, can you remember about the Pis-Pis, in Nicaragua?" He had recently met A. R. Gordon, manager of the Rosario mine in Honduras, and had been so impressed that on his visit with us H. A. hardly mentioned anything else. They took over all the Pis-Pis mines, Rosario with a 40 per cent and A S & R with a 60 per cent interest, and built a mill to treat 800 to 900 tons a day. Tonopah acquired La Luz y Los Angeles and Santa Rita and, with Ventures Ltd. of Toronto, put up a mill with some 1,100 tons daily capacity, which was increased after the war ended to 1,600 tons. I suppose they transferred the Eden, together with the piano, to Kursell's Neptune Gold Mining Company.

At the beginning of operations, and for a long time thereafter, La Luz took all its ore from the old open cut. For many decades, it contained as large a proportion of coarse free gold as did Homestake ore. More than half the recovery was in traps, followed by flotation and cyaniding. The Neptune mill was straight counter-current decantation cyanide treatment. From what I saw of those mines in the early days, I have always anticipated that if the pay ore continued at any considerable depth, sulfides would accompany the gold and very fine grinding of the pyrite after separation might be necessary. I've never had much use for witch doctors prognosticating around metal mines of any sort, especially some of them. But the only error of my own hunches has been in not heeding them. One observes, perceives, and makes deductions without conscious effort, often wondering how he ever arrived at an idea, but it just doesn't work out to tell anybody about it. Like the fellow listening to the traveling salesman in the smoking compartment and his story about the pig—"just never been in company before where I could tell it."

(To be continued.)



BLASTING ROCK TUNNELS UNDER A PITTSBURGH RESIDENTIAL DISTRICT

Some construction details on the Squirrel Hill Tunnel Project of B. Perini & Sons, Inc., Associated.

E. DONALD PHINNEY*

The hills, valleys, and rivers in and around Pittsburgh have contributed to the industrial growth of that big, bustling city in western Pennsylvania. As the metropolitan area has expanded, these natural advantages have helped to create difficult transportation problems. Many people who have traveled by automobile through Pittsburgh's streets, congested with trolley cars, buses, trailer trucks, and the traffic jams induced by the morning and evening rush of privately owned automobiles, have asked, "Why isn't something done about it?"

The Pennsylvania Department of Highways has come up with the answer—the construction of a federal-aid superhighway to connect with U. S. Routes 22 and 30, east and west of Pittsburgh. The new highway, to be known as the Penn-Lincoln Parkway Project, will provide a high-speed traffic artery for vehicles to get to the city's downtown business area quickly, or to by-pass the congested areas.

One important unit in this new superhighway is the Squirrel Hill Tunnel. The Pennsylvania Department of Highways awarded a contract for its construction on July 23, 1948, to the low bidder, B. Perini & Sons, Inc., Associated, Framingham, Massachusetts, on a bid of $13,767,843.10. The completion time for the contract, starting from September 7, 1948, is 730 days, based on calendar days.

One of the principal items in the contract is the driving of twin tunnels, 56 ft. by 26½ ft., on a tangent and parallel, each with an overall length of 4,225 ft. from portal to portal. Specifications for the south bore required drilling and blasting for 3,895 ft.; for the north bore, 3,785 ft. The tunnels

*Project Engineer, B. Perini & Sons, Inc., Associated, Squirrel Hill Tunnel Project, Pittsburgh, Pennsylvania.

OUTSIDE THE TUNNELS: The approach to the east portal during the early days of work on the project. Quonset huts at right house offices, engineering and supply departments, compressor room, and locker rooms.

MUCKING OUT: A short-boom 1½-cu. yd. Lorain shovel, powered by electricity (converted from Diesel), loading muck into a 15-cu. yd. Euclid truck for haulage to the disposal area.

were to be driven from the east portals on a 2.5 per cent ascending grade. Each tunnel was to be lined with reinforced concrete, with the walls approximately 27 in. thick, and the arched roof 24 in. thick. Upon completion, each bore was to contain a 24-ft. finished roadway and a 2-ft. 7½-in. service walk. Also included were cut-and-cover sections at both ends of the tunnels, grading and drainage of the approaches, and mass concrete in the ventilation buildings up to the electrical floor level. Eight cross passages, at 500-ft. intervals, provided access between the tunnels.

OPERATING SUPERVISORS: Some of the men directing operations on the Pittsburgh tunnel job: left to right, Oscar Cheff, shift superintendent; Charles H. Taylor, superintendent of tunnels; Louis L. Capone, project manager; E. Donald Phinney, project engineer.

Operating Cycle

The contractor started work at the east end, excavating the cut-and-cover section. After the tunnel headings had been advanced underground so that a systematic cycle of operations could be established, a 24-hour workday with three shifts, on a six-day-week basis, was adopted. The operating cycle included drilling, loading of the explosives, allocating time for adequate ventilation after each blast, examining and probing of the roof for evidence of loose rock, mucking out the blasted material, and erecting steel supports and lagging to support the roof in preparation for blasting the next round. Details were synchronized for continuous and alternate operations in both tunnels. This kept to a minimum the number of drillers, blasters, and muckers in each shift. The program called for drilling one heading and mucking the other—rotating the crews.

Holes for blasting in the headings of the tunnels were drilled from two three-deck steel-framed jumbos. Sixteen 3½-in. Model 350 Joy drifters were mounted on the jumbo in the north tunnel, and ten similar Joy drifters were mounted on the jumbo in the south tunnel. Tractors moved the jumbos to and from the headings. Enough track was maintained to permit pulling the jumbos back about 150 ft. from the headings, when blasts were fired. The drill steel used was 1¼-in. Crucible, with Timken detachable bits. Air for drill requirements and other supplementary air tools was supplied by four 750-c.f.m. Joy semi-portable compressors, all of which were electrically driven.

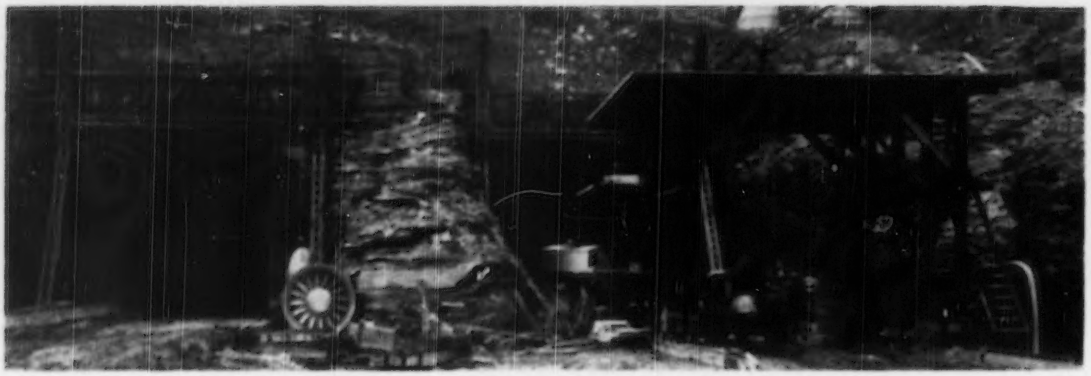
The progress made in advancing the tunnel headings was predicated on the type of rock encountered. This included shale, sandstone, and shaly limestone, very seamy and easily fragmented. The locations and numbers of drill holes in the rounds were changed to conform with the variations in the physical characteristics and the nature of the rock in the headings. The number of holes ranged from 85 to 130 a round, using a V-cut for the center holes. Spacing of drill holes in an average round was one hole for each 7 sq. ft. of heading.

Blasting and Excavating

The explosives used were Hercules* 30% and 40% Gelatin Extra, in 1¼ in. by 8-in. Tamptite* cartridges. The amount of the charges loaded into the drill holes was based on a ratio of approximately 1.75 lbs. of dynamite to 1 cu. yd. of rock in the solid. The charges were primed with Hercules No Vent* Delay Electric Blasting Caps, from zero delays in the cut holes up to and including the thirteenth period of delays, in concentric rings to the rib holes. The leg wires

*Reg. U. S. Pat. Off.

LOADING EXPLOSIVES: The drill holes in a heading are being loaded with 30% and 40% Gelatin Extra. The loading ratio, in most of the rounds, was 1.75 lbs. of dynamite to 1 cu. yd. of rock. The average blast produced 32 cu. yds. of broken rock per one lineal foot of tunnel.



TWIN TUNNELS: The portals of the two 36-ft. by 26½-ft. Squirrel Hill tunnels in Pittsburgh, soon after underground operations had begun. The jumbo, at right, is being readied to drill the first full round in the north tunnel.

of the caps were connected to two bus wires, with closed loops—the electric current for firing the round being applied at both ends. Blasts were fired from 440-volt a.c. firing switches, located 1,500 ft. from the headings. The average blast produced 32 cu. yds. of broken rock per lineal foot of tunnel. The rock was broken to about quarry size, providing easy digging, in most cases, for the 1¾-cu. yd. shovels.

After blasts, the muck was loaded out by two short-boom 1¾-cu. yd. power shovels, one a Lorain and the other a Northwest. Originally, these shovels were Diesel-powered; they were converted to electric power for use in the tunnels. The shovels loaded out the muck at the headings into a fleet of 15-cu. yd. Euclid trucks, for transportation to a nearby spoil area. An ingenious method of turning the trucks around near the tunnel headings instead of backing them in from the portal saved an appreciable amount of time in mucking operations. The tunnel headings were ventilated by five Joy axial-flow fans of 54-in. diameter, each powered by a 75-hp. motor. The fans either blew air into or sucked air out of the tunnels, depending upon which heading was blasted. This ventilation system supplied 240,000 c.f.m. of air to the underground operations.

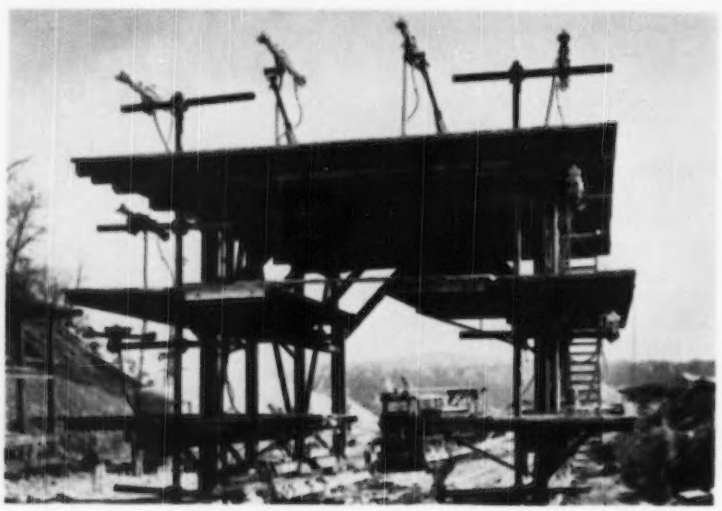
Tunnel Supports

Steel supporting ribs, supplied by Commercial Shearing and Stamping Company, were set by the drilling crews, working from the jumbos. Side beams were hoisted into place by an Ingersoll-Rand utility hoist, mounted on the top deck. Roof beams were lifted and bolted into place by the crew. Areas between the ribs and the rock were blocked up with timber to prevent further caving. Lagging was placed where necessary.

Each tunnel was lighted from the portal to within 100 ft. of the heading, with 50-watt lamps spaced 8 ft. apart. On each jumbo, the lighting included two 200-watt floodlamps, to illuminate the heading. A cluster of lights of one to four 150-watt lamps was installed over the drifter drills.

The contract of B. Perini & Sons, Inc., Associated, is being constructed under the supervision of the Pittsburgh District of the Pennsylvania Department of Highways, with E. L. Schmidt the chief engineer of the department. G. E. Riley is resident engineer on the Squirrel Hill job.

For the contractor, Louis L. Capone is project manager; Charles H. Taylor, tunnel superintendent; the author, project engineer; Robert E. Bradley, design engineer; Oscar Cheff, Carter Fore, and Leo Pfligor, shift superintendents; Anthony Casali, master mechanic; Albert Greaves, master electrician; Albert Spernack, "Dutch" Rape, and Angelo Sciullo, shift engineers. The office manager on the project is Fernand Di Berto.



DRILL JUMBO: Front view of the three-deck steel-framed drill jumbo used in the north tunnel on which 16 model 350 Joy drifters were mounted. Center sections are lowered to permit the shovel and trucks to pass through. A tractor moved the jumbo to and from headings.

READY TO BLAST: The line of ditch in the swamp on the south shore before blasting.

RESULTS EXCELLENT: Blasting by the propagation method in the south shore swamp produced a ditch 32 ft. wide and 6 ft. deep.

A DIFFICULT PIPE-LINE RIVER CROSSING

(Continued from page 143)

of the size of the rock pile, the barge could not proceed farther, and the dynamite cartridges were hand-strung toward the north shore from a 12 by 12-ft. raft which was fastened to the heavy cable and moved by poling. Also, cartridges were laid from a similar raft which moved out from the shore to meet the one from the barge.

To blast the ditch through the 800 ft. of swamp on the north shore, holes 48 in. deep on 15-in. centers were loaded with six cartridges of 1⅛ by 8-in. 50% N.G. dynamite. This relatively heavy loading was used because the material was difficult to move and because it was uncertain how long the explosives would have to remain in the wet muck before being fired. The blast was detonated the next day, producing a very satisfactory ditch 7 ft. deep.

The ditching crew consisted of 12 men: 4 on punch bars, 4 loading the explosives, and 4 tamping the holes. The charges in the line of holes were detonated with one No. 6 Electric Blasting Cap fired by a Hercules 10-cap blasting machine from a sheltered spot about 800 ft. upwind from the north end of the blast.

Blasting in the Lake Bottom

The tie-in point (see diagram) was about 50 ft. inland from the south bank of the lake. On that side the lake was too shallow for the barge to reach the bank. At first it was planned to muck the barge ashore and to the tie-in point. From there the pipe could be pulled across the lake with a winch, and the pipe could be handled for the tie-in with the dragline. But mucking with the steam rig was slow, and it was decided to try another method. From the south end of the main line of charges, two parallel lines of explosives were laid 8 ft. apart. This was about 100 ft. out from the south shore. Cartridges of 60% Gelatin Extra, 5 in. by 25 lbs., were spaced 4 in. apart, end to end.

By that time the wind was blowing so hard that it was necessary to again postpone the work. The barge was in

MEN ON THE JOB. Left to right, the author; C. G. Griffis, the contractor; W. E. Bolt, lake crossing superintendent; and George Hair, division superintendent of Ford, Bacon and Davis, Inc.

shallow water, directly over the line of explosives with all the grousers dropped, and held in place also by the clam bucket and the guide cable. It was feared that the edge of the barge, which was moved up and down to some extent by the waves, might cut the line of explosives and the plastic-covered Primacord.

These fears proved to be well-founded. When the blast was fired from the north end of the line, the explosives detonated only as far as the point where the barge had been anchored. The remaining section was detonated from the south side of the lake, and the short distance between the ends of the two ditches on the lake bottom was easily mucked out with the dragline. Soundings showed that the ditch was exactly what the specifications called for.

The double row of explosives from the south shore produced a ditch 32 ft. wide and 6 ft. deep, which made it possible for the barge to reach the bank without mucking.

On the next day, the 1,300 ft. of ditch through the swamp, up to the tie-in point, was blasted. Each hole was loaded with four cartridges of ditching dynamite, 1¼ by 8-in., on 18-in. centers, at a depth of 42 in. The blast produced a fine, clean ditch having a depth of 6½ ft.

All was now clear for the pipe to be hauled across from the north side of the lake, to be tied onto the pipe on the south side. Everyone interested in the project agreed that it had been carried through against many difficulties and in a very satisfactory manner.

Island Creek's Mine No. 27

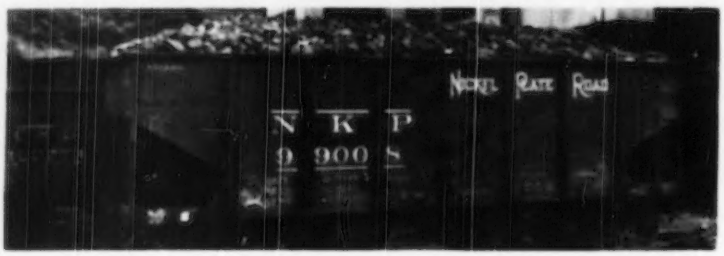
(Continued from page 147)

Coal-Preparation Plant

The coal is conveyed from the bottom up a 513-ft. slope to a modern preparation plant. This plant is constructed of steel and concrete with aluminum siding, designed and erected by Roberts and Schaefer Company, Chicago, Illinois.

The coal from the belt is screened at the rate of 350 tons per hour into plus 5 in. and 5 in. by 0 on the run-of-mine table. Plus 5-in. coal is hand-picked and loaded into railroad cars. The 5-in. by 0 size is screened at ¾ in. with the 5 by ¾ in. going to a Link-Belt trough separator. The rejects from the trough are fed to a Link-Belt baum jig. The 5 by ¾-in. clean coal is classified and dewatered on a Parrish-type shaker screen. Prepared sizes from this screen are 5 by 3 in., 3 by 2 in., 2 by 1¾ in. and 1¾ by ¾ in. The 2 by 1¾ in. goes directly to a bin, or it may be loaded into railroad cars. The 5 by 3-in. and 3 by 2-in. sizes may be loaded separately or combined into 5 by 2-in. egg. The 1¾ by ¾ in. goes to a secondary dewatering screen and from there to its bin.

The ¾-in. by 0 raw coal is fed to a Hydrotator-Classifier wet-washing system. After washing, it is centrifugally dried in two CMI driers and the partially dried product is completely dried in a flash drier. After drying, the ¾ in. by 0 may be loaded directly into railroad cars or placed in its bin. Froth flotation is utilized to recover the fines



READY FOR SHIPMENT. A car of plus 5-in. lump coal loaded and ready to be speeded to its destination over a specially built line of the Chesapeake & Ohio Railroad Company.

from the washery water. The minus 2-in. sizes may be combined into various proportions from their bins before loading.

Quality of product is constantly under scrutiny by mine management. Periodic samples are taken of all sizes on which the laboratory conducts tests and analyses to determine chemical and physical properties of the product. Any departures from predetermined standards are reported to all segments of management and are dealt with immediately.

OPERATING PERSONNEL: The men who help to keep operations running smoothly at Mine No. 27: left to right, Robert Maynard, preparation plant foreman; T. H. Strunk, mine superintendent; Rhein Tinsley, general mine foreman; Jennings Mitchell, chief electrician.

THE AUTHOR: Nicholas T. Camicia, division superintendent, Island Creek Coal Company, Holden, West Virginia.

The average ash analysis for various sizes of the prepared coal is as follows:

5 by 3 in.	4.28
3 by 2 in.	4.49
2 by 1¼ in.	4.64
1¼ by ¾ in.	4.94
¾ in. by 0	5.04
2 in. by 0	4.89

The loaded railroad cars are constantly under observation by a man at each loading boom, and each car is inspected and trimmed carefully before leaving for its destination. The coal shipped from Mine No. 27 is destined primarily for metallurgical uses, in the making of high-grade steel, and as a premium coal for domestic use.

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Low maintenance is assured by such features as a replaceable bronze chuck rotation nut to protect piston splines from scoring and a replaceable bronze cylinder bushing liner to make it easy to maintain piston alignment and full cushioning.

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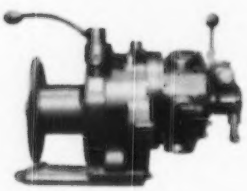

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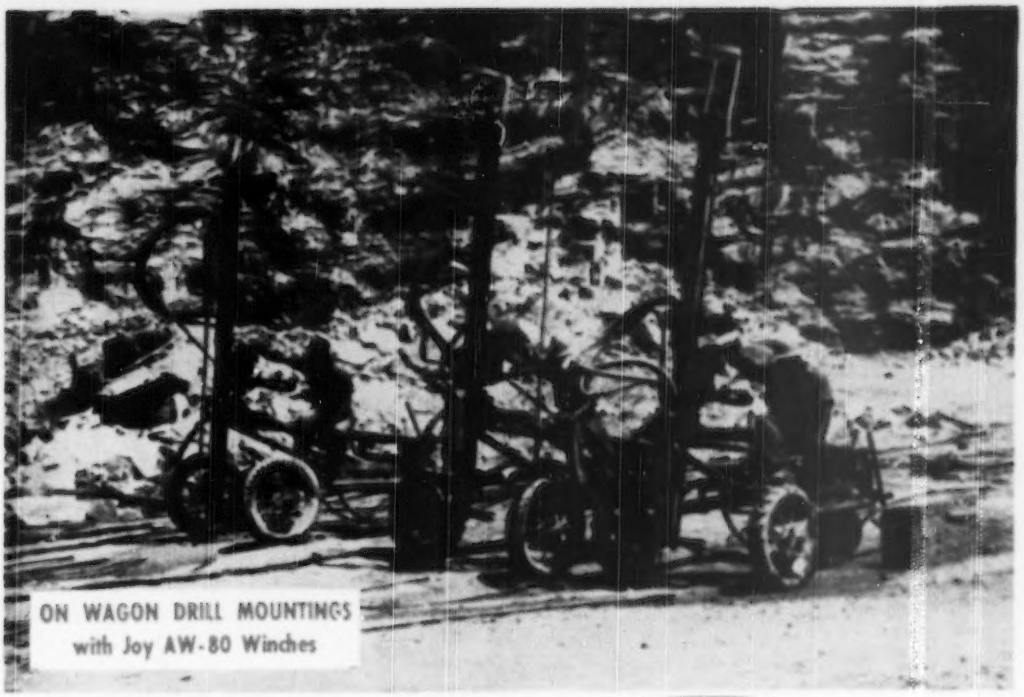

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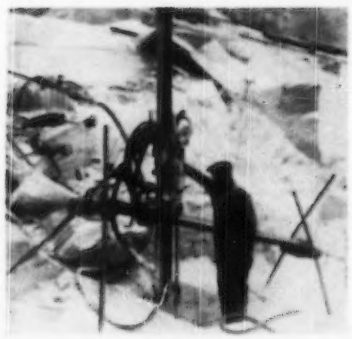

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Reinforced with rayon yarn, it is stronger and lighter in weight. Finished with a smooth, tough seamless plastic covering, it is waterproof and resistant to acids encountered in mineral ores. It does not become brittle or crack in cold weather, nor is it affected on hot summer days, and it is not a conductor of electricity.

PLASTIC-Reinforced Primacord is your best bet in all deep, wet holes—in preloading, pipe line river crossings, horizontal holes, marine work, coyote tunnels and sleeper shots for seismograph work.

Plastic Reinforced Primacord is recommended for "down" lines where you formerly used Wire Countered Primacord.

1. To make the most effective hookup, use a simple clove hitch in the *ground* line, as shown in these three photographs.

2. The twin loops have been folded over to form a hole.

3. Pass the Plastic Reinforced Primacord through this hole and draw the knot up *tight*.

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